Insitu X-ray photoelectron Spectroscopy (XPS) characterization of nanofilms grown by Atomic Layer Deposition (ALD)

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Abstract:

Atomic Layer Deposition (ALD) is a materials growth technique with effectively monolayer control which is being increasingly used to fabricate a wide range of advanced materials for many technological applications. These films which have thickness in the nanoscale are nowadays widely employed in a variety of important technologies such as electronic devices (as dielectric insulators in MOS structures), hard drives (as protective films) and MEMS (as lubricants). Due to their nano-scale thickness, atomic transport processes that in normal materials would not be of significance, can greatly affect the chemical makeup of nanofilms during processing (deposition) and their subsequent functionality.

X-Ray Photoelectron Spectroscopy (XPS) is a measurement technique used to characterize the chemical composition of surfaces and interfaces. When these spectra are acquired in an angle resolved (AR) mode, it is possible to derive information about the elemental distribution perpendicular to the surface. The photoemission signal originating from atoms which are localized a certain depth from the surface is smaller at grazing angles of emission than for normal emission. In contrast, if the atoms are localized at the surface, the signal will be the same independent of angle of emission. Using appropriate software analysis, these differences permit the characterization of the elemental profile perpendicular to the surface in a non-destructive manner which is critically important in the characterization of nanofilms grown by ALD.